

New

GPIB

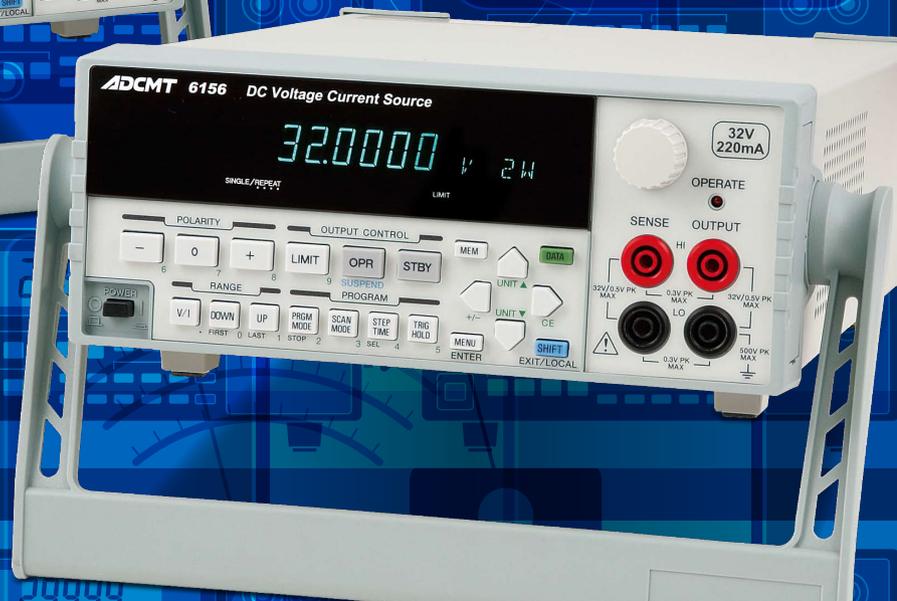
USB

BCD

Factory option

**Standard power source best used
as calibrator and secondary battery simulator**

- **Wide dynamic range of sourcing**
6146 Voltage: 0 to $\pm 32.000\text{V}$ Current: 0 to $\pm 220.00\text{mA}$
6156 Voltage: 0 to $\pm 32.0000\text{V}$ Current: 0 to $\pm 220.000\text{mA}$
- **High resolution**
1 $\mu\text{V}/100\text{nA}$ (6146), 100nV/10nA (6156)
- **High accuracy (one-year guarantee)**
Basic accuracy for voltage: $\pm 0.025\%$ (6146), $\pm 0.015\%$ (6156)
Basic accuracy for current: $\pm 0.03\%$ (6146), $\pm 0.02\%$ (6156)
- **Synchronous operation of multiple units**
- **JIS-compliant thermal electromotive force output function (6156)**





6156

The 6146/6156 is a precision DC voltage/current source suitable for characteristic evaluation of semiconductor or electronic components and modules in R&D fields and for calibration of meters or measuring instruments.

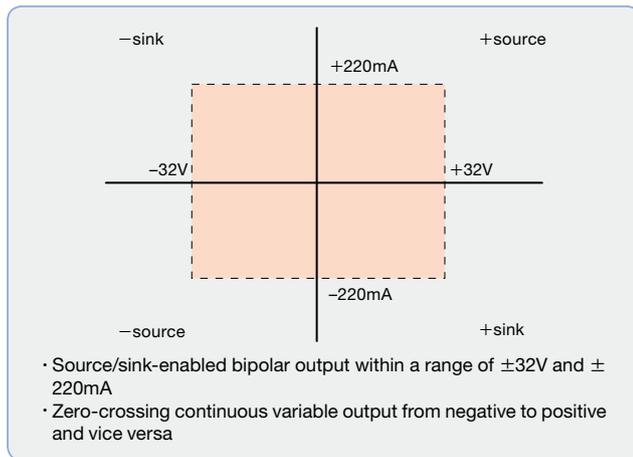
It achieves wide dynamic range, high resolution, high accuracy and low output noise based on the comprehensive DC voltage/current sourcing technologies of ADC, allowing highly reliable and high-throughput system architect.

With various user-friendly functions, the 6146/6156 can not only operate as stand-alone but also can be integrated into an auto measuring system as secondary battery simulator.

In addition, the 6156 is equipped with a thermal electromotive force output function compliant with JIS, allowing easy temperature calibration.

Feature

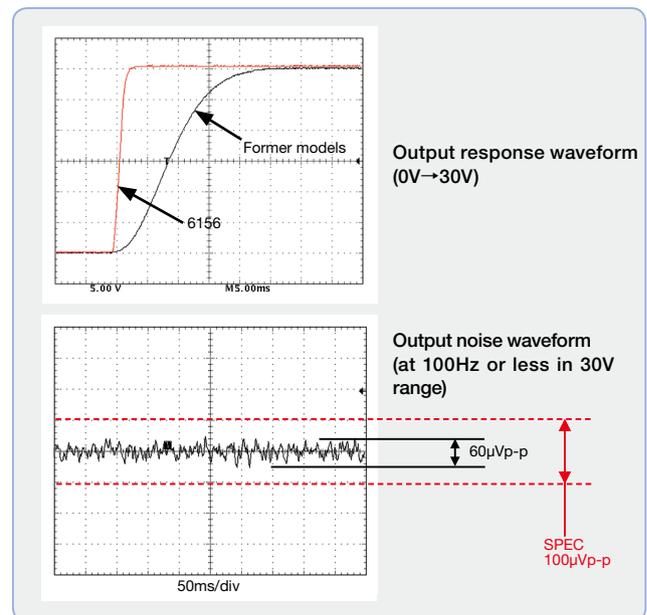
Wide Dynamic Range of Sourcing



Model	6146	6156
Digits	4½	5½
Output	Bipolar	
Maximum output	$\pm 32\text{V} / \pm 220\text{mA}$	
Voltage source range	1 μV to 32.000V	100nV to 32.0000V
Voltage source accuracy (typical)	0.025%	0.015%
Current source range	100nA to 220.00mA	10nA to 220.000mA
Current source accuracy (typical)	0.03%	0.02%
Thermal electromotive force sourcing	—	Available
High-frequency output noise (20MHz)	3mVp-p	
Settling time	10ms	
Interface	GPIB, USB (standard) and BCD (factory option)	
Memory	Up to 5000 data	

High-Speed Response and Low Noise Voltage/Current Sourcing

The response time in voltage or current sourcing of the 6146/6156 is greatly improved compared to the former models, and the settling time to reach the final value $\pm 0.1\%$ of 10ms or less is achieved. Consequently, the characteristic evaluation time for components or modules or the takt time for automatic test can be greatly reduced. Also, it features low output noise of 100 $\mu\text{Vp-p}$ (30V range, DC to 100Hz band), enhancing the measurement reliability in characteristic evaluation of semiconductors or sensors.



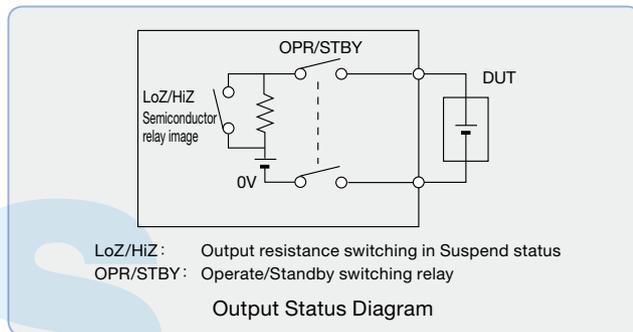
Suspend Function Suitable for Automatic Tests

When DUTs such as electronic components or modules are replaced on automatic test equipment, the output status needs to be “Standby” that opens the output relay so as not to apply unnecessary voltage to the DUTs. Every switching between “Operate” and “Standby” turns ON or OFF the output relay, giving a great impact on the relay lifetime.

The 6146/6156 has a suspend function that keeps the output status in “high impedance (HiZ: output relay ON, high resistance)” or “low impedance (LoZ: output relay ON, low resistance)” without switching the relay. The output OFF status can be selected from these two statuses and “Standby (output relay OFF).”

Using this function can extend the relay lifetime and improve the system throughout.

In addition, it can prevent transient current from being generated when connecting voltage sourcing devices such as batteries.

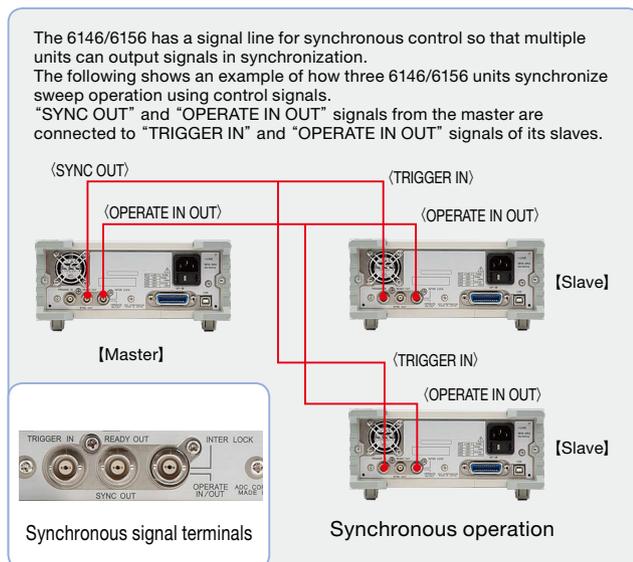


Multiple-Unit Operation and Synchronous Operation with DMM

In an electronic device or module test, voltage sometimes needs to be applied from more than one source. In this case, voltage to be applied to DUTs needs to vary in a synchronous timing.

More than one 6146/6156 units can be synchronized by connecting the Operate and Standby timing signals and variable voltage timing signals from the master to its slaves.

For voltage measurement using DMM, the 6146/6156 builds up an automatic measuring system with the DMM with the minimum waiting time as voltage application timing and measurement timing can be synchronized.

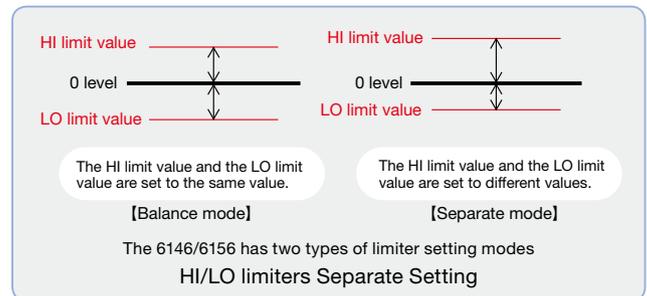


HI/LO Limiters Separate Setting

The limiter function is highly important for voltage or current sourcing to protect connected devices.

The current limiter works for voltage source to restrict output current and the voltage limiter works for current source to restrict compliance voltage.

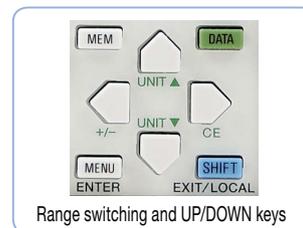
The 6146/6156 has two setting levels for both voltage and current limiters which can be set separately.



User Friendly Operation Panel

Voltage or current values to be generated can be entered directly using the keyswitches on the front panels, and can be varied (increased or decreased) continuously by specifying an arbitrary digit using the rotary knob or the UP and DOWN keys.

Thus, the operability is greatly improved, so that measurement such as a device input and output characteristic test can be performed by simple key operations.



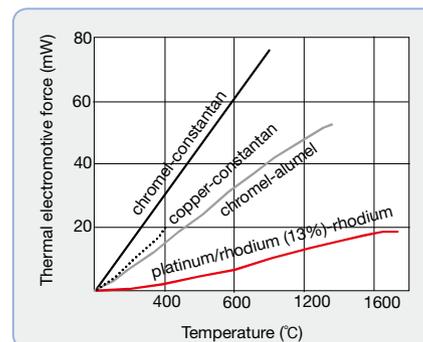
Thermal Electromotive Force Output Function (6156 Only)

The 6156 is capable of generating thermal electromotive force of thermocouples in accordance with JIS standards. Selecting the type of thermocouple and temperature to be generated will output voltage corresponding to the setting temperature.

The type of thermocouple is selectable from type T, J, E, K, S, R, B and N. The JIS standard is JISC1602-1995 or JISC1602-1981. For type N, only JISC1602-1995 is applicable.

The reference junction compensation is at 0°C or arbitrary temperature (user selectable).

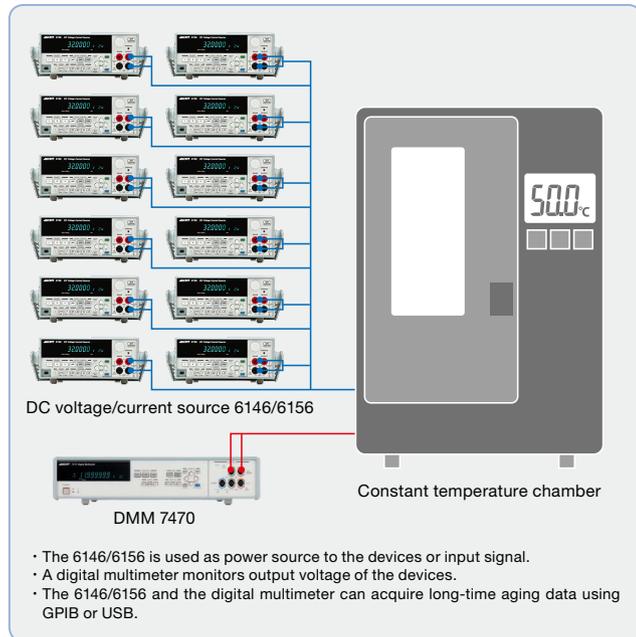
This function enables temperature calibration of thermometers and other measuring instruments.



The 6156 thermal electromotive force output function can linearize the temperature and the thermal electromotive force of each thermocouple. Thus, thermometers can be calibrated easily just by setting the temperature to be calibrated on the 6156.

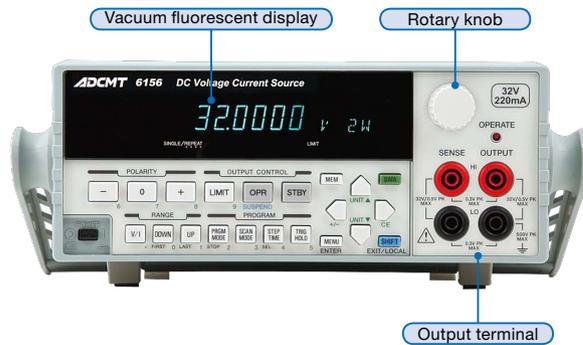
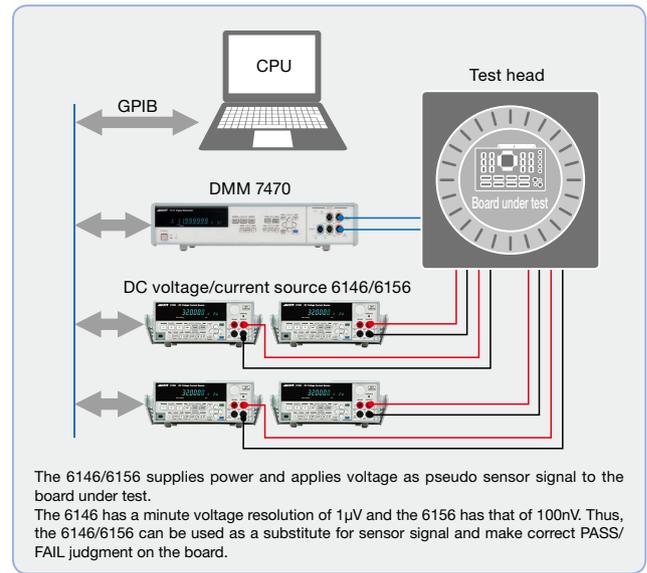
For Reliability Test of Semiconductors and Electronic Components

To secure the reliability of electronic components such as semiconductor and sensors, aging tests with current applied are conducted on the devices. Such tests require highly stable voltage sources. In some tests, the normal operating range of the devices is verified by changing the supply voltage. With its low noise, high stability and high sourcing resolution, the 6146/6156 offers high reliability in these tests.

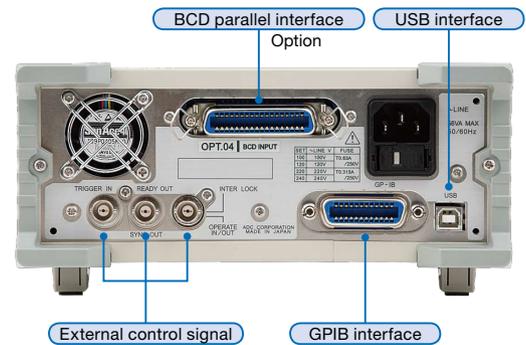


For Embedded Power Source or Signal Source in a Board Tester

Control boards used in home electric appliance and industrial equipment undergo functional tests at shipping and incoming inspections. The 6146/6156 can be used as embedded power source in a board tester, applying voltage to a board under test and applying voltage or current as pseudo sensor signal. As the 6146/6156 stabilizes its output values with a settling time of 10 msec or less, the time of a multi-item test can be reduced. In addition, the 6146/6156 is equipped with GPIB and USB interfaces for remote control as standard, allowing highly flexible system architect.



Front Panel (6156)



Rear Panel (6146/6156)

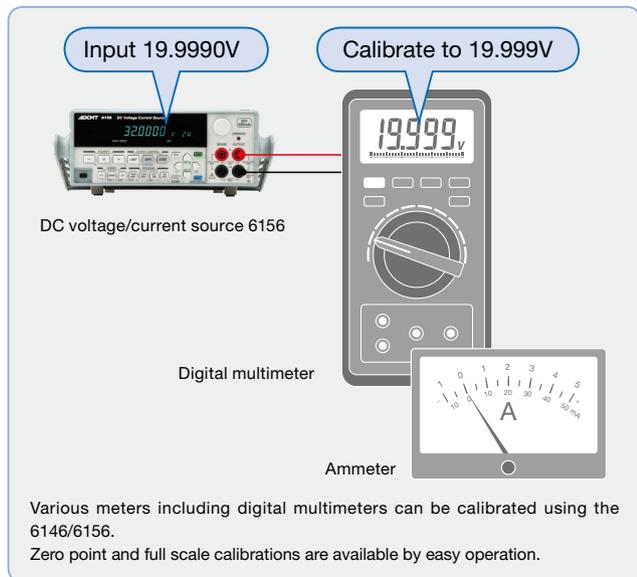
Applicat

For Calibration of Meters and Measuring Instruments

Meters or measuring instruments used in plants or instrumentation systems need to be calibrated periodically.

The 6146/6156 is suitable for calibration of these meters or instruments with its high source accuracy.

The calibration time can be reduced by storing voltages or currents of points to be calibrated in the memory of the 6146/6156 and reading them out by turns.



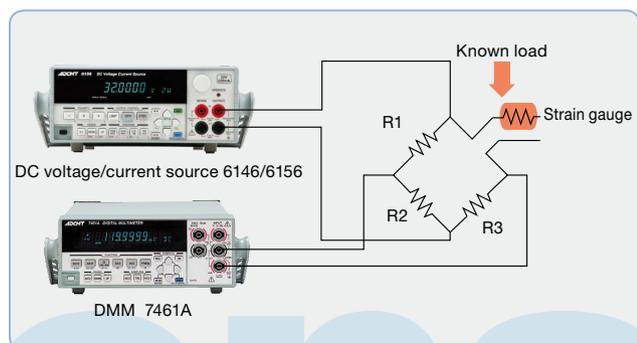
For Characteristic Test of Strain Sensors (Strain Gauges)

A strain gauge used in a strain or pressure sensor utilizes subtle variation in resistance.

In a strain gauge test, resistance with a known load applied is measured using a Wheatstone bridge circuit.

As a voltage source for the Wheatstone bridge circuit, the 6146/6156 is best suited with its high stability.

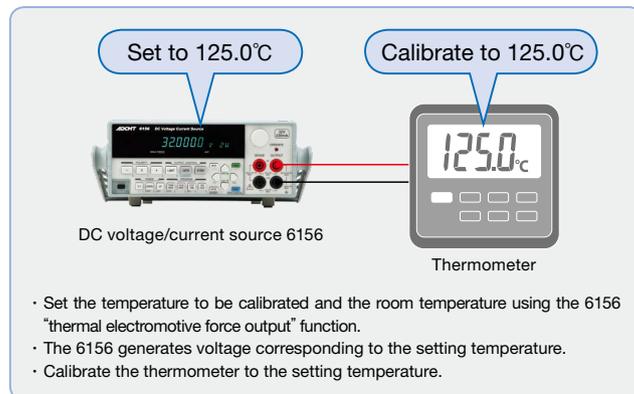
The output voltage is measured by using a digital multimeter such as the 7461A.



For Calibration of Thermometers (6156 Only)

When calibrating a thermometer that uses a thermocouple as a temperature sensor, DC voltage corresponding to thermal electromotive force of the thermocouple needs to be applied.

The 6156 generates easily thermal electromotive force of thermocouples compliant with JIS. For reference junction compensation, the 6156 has a "room temperature compensation ON/OFF" function that generates thermal electromotive force to arbitrary temperature just by setting the source temperature and the room temperature.



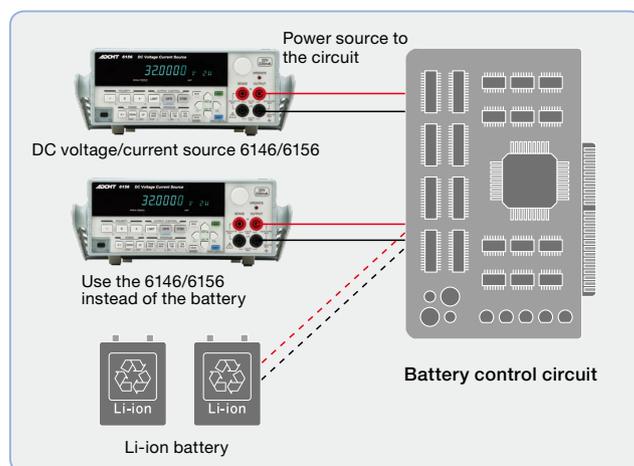
For Evaluation Test of Secondary Battery Control Circuits

As a secondary battery such as a lithium ion battery is high-energy density, the control circuit plays an important role in monitoring the charge-discharge characteristics.

To test the operation of this control circuit, the 6146/6156 can be used as a battery simulator.

The control circuit is tested correctly by changing the voltage of the battery simulator for each test item.

The 6146/6156 realizes such precise characteristic measurement with its wide measurement range, high sourcing resolution and low output noise.



Specifications

All accuracy specifications are satisfied at a temperature of 23°C ±5°C and a relative humidity not exceeding 85%.

Voltage/current source

6146

Voltage source range:

Range	Source range	Setting resolution
30mV	0 to ±32.000mV	1μV
300mV	0 to ±320.00mV	10μV
3V	0 to ±3.2000V	100μV
30V	0 to ±32.000V	1mV

Current source range:

Range	Source range	Setting resolution
3mA	0 to ±3.2000mA	100nA
30mA	0 to ±32.000mA	1μA
200mA	0 to ±220.00mA	10μA

Overall accuracy: Includes calibration accuracy, 1-day stability, the temperature coefficient, and linearity.

1-day stability: At constant power and load

Temperature coefficient: At temperature of 0 to 50°C

Voltage source:

Range	Overall accuracy (1 year)	Overall accuracy (90days)	1-day stability (23°C±1°C)	1-day stability (23°C±5°C)	Temperature coefficient
	± (% of setting+V)				± (ppm of setting+V) /°C
30mV	0.03+5μV	0.025+4μV	0.006+4μV	0.01+4μV	20+200nV
300mV	0.03+25μV	0.025+20μV	0.006+5μV	0.01+10μV	20+2μV
3V	0.025+200μV	0.02+200μV	0.005+20μV	0.008+30μV	15+10μV
30V	0.025+2mV	0.02+2mV	0.005+100μV	0.008+200μV	15+40μV

Current source:

Range	Overall accuracy (1 year)	Overall accuracy (90days)	1-day stability (23°C±1°C)	1-day stability (23°C±5°C)	Temperature coefficient
	± (% of setting+A)				± (ppm of setting+A) /°C
3mA	0.03+250nA	0.025+250nA	0.008+20nA	0.01+20nA	20+4nA
30mA	0.03+2.5μA	0.025+2.5μA	0.008+200nA	0.01+200nA	20+40nA
200mA	0.035+25μA	0.03+25μA	0.008+2μA	0.01+2μA	20+400nA

Source linearity: ±60ppm of range or less

6156

Voltage source range:

Range	Source range	Setting resolution
30mV	0 to ±32.0000mV	100nV
300mV	0 to ±320.000mV	1μV
3V	0 to ±3.20000V	10μV
30V	0 to ±32.0000V	100μV

Current source range:

Range	Source range	Setting resolution
3mA	0 to ±3.20000mA	10nA
30mA	0 to ±32.0000mA	100nA
200mA	0 to ±220.000mA	1μA

Overall accuracy: Includes calibration accuracy, 1-day stability, the temperature coefficient, and linearity

1-day stability: At constant power and load, and temperature of 23°C±1°C

Temperature coefficient: At temperature of 0 to 50°C

Voltage source:

Range	Overall accuracy (1 year)	Overall accuracy (90days)	1-day stability	Temperature coefficient
	± (% of setting+V)			± (ppm of setting+V) /°C
30mV	0.02+5μV	0.018+5μV	0.002+3μV	15+200nV
300mV	0.02+10μV	0.018+10μV	0.003+3μV	15+700nV
3V	0.015+80μV	0.008+70μV	0.001+10μV	8+7μV
30V	0.015+240μV	0.01+200μV	0.001+40μV	8+25μV

Current source:

Range	Overall accuracy (1 year)	Overall accuracy (90days)	1-day stability	Temperature coefficient
	± (% of setting+A)			± (ppm of setting+A) /°C
3mA	0.02+50nA	0.018+50nA	0.0015+15nA	15+4nA
30mA	0.02+500nA	0.018+500nA	0.0025+150nA	15+40nA
200mA	0.025+5μA	0.022+5μA	0.004+1.5μA	20+400nA

Source linearity: ±6ppm of range or less

Thermal electromotive force

6156 only

Thermal electromotive force source range:

Thermocouple	Source range	Setting resolution
T (CC)	-200.0°C to +400.0°C	0.1°C
J (IC)	-200.0°C to +1200.0°C	0.1°C
E (CRC)	-200.0°C to +1000.0°C	0.1°C
K (CA)	-200.0°C to +1372.0°C	0.1°C
S (PR10)	-10.0°C to +1768.0°C	0.1°C
R (PR13)	-10.0°C to +1768.0°C	0.1°C
B (PR30)	+330.0°C to +1820.0°C	0.1°C
N	-200.0°C to +1300.0°C	0.1°C

Room temperature setting range: -25°C to +85°C

For thermocouple type B, the room temperature of less than 0°C is deemed to be 0°C.

Standard setting: JIS C1602-1995 or JIS C1602-1981

For type N, JIS C1602-1995 is applied.

Thermal electromotive force overall accuracy:

Thermocouple	Source temperature range	Accuracy	
		Range	± (% of setting+°C)
T (CC)	-200.0°C to +400.0°C	-200.0°C to -120.1°C	0.034+0.5°C
		-120.0°C to -50.1°C	0.025+0.3°C
		-50.0°C to +400.0°C	0.02+0.2°C
J (IC)	-200.0°C to +1200.0°C	-200.0°C to -150.1°C	0.035+0.6°C
		-150.0°C to -50.1°C	0.025+0.5°C
		-50.0°C to +1200.0°C	0.02+0.4°C
E (CRC)	-200.0°C to +1000.0°C	-200.0°C to -150.1°C	0.035+0.5°C
		-150.0°C to -50.1°C	0.026+0.4°C
		-50.0°C to 1000.0°C	0.02+0.3°C
K (CA)	-200.0°C to +1372.0°C	-200.0°C to -150.1°C	0.037+0.7°C
		-150.0°C to -50.1°C	0.026+0.6°C
		-50.0°C to +1100.0°C	0.02+0.4°C
		+1100.1°C to +1372.0°C	0.023+0.4°C
S (PR10)	-10.0°C to +1768.0°C	-10.0°C to +550.0°C	0.02+1°C
		+550.1°C to +1768.0°C	0.02+0.6°C
R (PR13)	-10.0°C to +1768.0°C	-10.0°C to +300.0°C	0.02+0.7°C
		+300.1°C to +1768.0°C	0.02+0.6°C
B (PR30)	+330.0°C to +1820.0°C	+330.0°C to +1000.0°C	0.02+1.5°C
		+1000.1°C to +1820.0°C	0.02+0.7°C
N	-200.0°C to +1300.0°C	-200.0°C to -130.1°C	0.04+1°C
		-130.0°C to -50.1°C	0.025+0.7°C
		-50.0°C to +1300.0°C	0.02+0.5°C

6146/6156

Maximum load/output resistance:

3V/30V range: output resistance in 4-wire connection

Other ranges: output resistance in 2-wire connection

	Range	Maximum load	Output resistance
Voltage source	30mV	1.5μA*1	Approx. 2Ω
	300mV	15μA*1	
	3V	±220mA	2mΩ or less
	30V		2mΩ or less
Current source	3mA	Output compliance voltage: ±32V	500MΩ or higher
	30mA		320MΩ or higher
	200mA		32MΩ or higher

*1 : Load that gives an error of 0.01% of the range

Output noise: Voltage source: within the range from no-load to maximum load
Current source: at load resistance of 1k Ω

	Range	Low frequency noise		High frequency noise
		DC to 100Hz	DC to 10kHz	DC to 20MHz
Voltage source [Vp-p]	30mV	5 μ V	10 μ V	3mV
	300mV	15 μ V	30 μ V	
	3V	30 μ V	120 μ V	
	30V	100 μ V	300 μ V	
Current source [Ap-p]	3mA	30nA	100nA	6 μ A
	30mA	300nA	400nA	
	200mA	3 μ A	3 μ A	

Settling time: Time to settle to the final value $\pm 0.1\%$ when varying from zero to the full scale.

Setting conditions: Source values and limiter values are full-scale settings.

Load conditions: Pure resistive load and 200pF max. load capacitance

	Range	Settling time
Voltage source	30mV	10ms or less
	300mV	
	3V	
	30V	
Current source	3mA	10ms or less
	30mA	
	200mA	

Overshoot: $\pm 0.1\%$ max., pure resistive load, at end of standard cable

Line regulation: $\pm 0.003\%$ of range or less

Load regulation: $\pm 0.003\%$ of range or less (in 4-wire connection with maximum load)

(excluding the 30mV and 300mV ranges)

Maximum load capacitance: Maximum value that does not oscillate in voltage source or voltage limiter

Voltage source/voltage limiter: 1000 μ F

Maximum load inductance: Maximum value that does not oscillate in current source or current limiter

Current source/current limiter: 1mH

CMRR: Voltage output 100dB or higher

Current output 72dB or higher

At unbalanced impedance 1k Ω and in DC and AC 50/60Hz $\pm 0.1\%$

Voltage/current limiter:

	Setting range	Resolution	Setting accuracy
Voltage limiter	1V to 32V	100mV	$\pm 5\%$ of setting ± 100 mV
Current limiter	5mA to 220mA	1mA	$\pm 10\%$ of setting ± 1 mA ± 60 μ A/1V

※The current limiter is available in the 3V and 30V ranges.

Source Function

Memory recall: Reads out a specified memory number.

Reads out memory numbers by turn at intervals specified by the step time.

Scan mode: Hold Reads out a memory number by trigger input.

Single Scans once from the first number through the last number.

Repeat Scans repeatedly from the first number through the last number.

Maximum memory: 5000 data

Step time: Setting range 0.02 to 10.00s, setting resolution 0.01s

Sweep function: Increments or decrements the source value by the step value from the specified start value to stop value.

Suspend function: Can be selected between HiZ (high resistance) and LoZ (low resistance) with the output relay ON.

Continuous variable function:

Increments or decrements the current setting value to the full scale or zero at intervals specified by the step time.

Limiter: Voltage and current limiters are separately set.

Current limiter in voltage source

Voltage limiter in current source

HI and LO limit values can be set separately.

Output system: Floating, bipolar

Output terminal: Front, safety socket

HI OUTPUT, HI SENSE, LO OUTPUT, LO SENSE

Maximum input: HI-LO 0.5V peak Max (30mV/300mV range)

32V peak Max (3V/30V range)

OUTPUT-SENSE 0.3V peak Max

LO-chassis 500V peak Max

Maximum remote sensing voltage:

HI OUTPUT-HI SENSE ± 0.3 V Max

LO OUTPUT-LO SENSE ± 0.3 V Max

(The voltage between HI SENSE and LO SENSE must be within the maximum output voltage range)

GPIO interface: Compliant with IEEE-488.2-1987

Interface function SH1, AH1, T6, L3, SR1, RL1, PP0, DC1, DT1, C0, E2

Connector Amphenol 24pin

USB interface: USB 2.0 Full-speed

Connector Type B

BCD parallel interface (factory option):

Remote programming output level, polarity, range, Operate, load signal

Connector Amphenol 36 pin

External control signal:

TRIGGER IN

READY OUT/SYNC OUT

INTERLOCK/OPERATE IN/OPERATE OUT,

Connector BNC

Operate hold function:

Starts up with output ON at recover from a power failure.

General Specifications

Operating environment: Ambient temperature 0°C to +50°C

Relative humidity 85% or below, with no condensation

Storage environment: Ambient temperature -25°C to +70°C

Relative humidity 85% or below, with no condensation

Warming up time: 30 minutes or longer

Display: 5-digit decimal (6146)/6-digit decimal (6156)

7-segment vacuum fluorescent display

Power supply: AC power 100V/120V/220V/and240V (User selectable)

Option No.	Standard	OPT. 32	OPT. 42	OPT. 44
Power Voltage	100V	120V	220V	240V

Specify the option number when ordering.

When changing the power voltage, use only a power cable and rated fuse approved for the respective country.

Line frequency: 50Hz/60Hz

Power consumption: 56VA or less

Dimensions: Approx. 212 (width) \times 88 (height) \times 340 (depth) mm

Mass: 4kg or less

Safety: Compliant with IEC61010-1 Ed.3

EMI: Compliant with EN61326 classA

Supplied accessories

Part number	Name
A01402	Power cable (JIS 2m)
A01044	Input and output cable (safety plug)
A08531	Banana tip adapter (for A01044)
A08532	Alligator clip adapter (for A01044)

Option

	Option number
BCD parallel interface	6146+04
	6156+04

Optional accessories

Part number	Name
A01041	Input cable (test probe)
A01044	Input and output cable (safety plug)
A08531	Banana tip adapter (for A01044)
A08532	Alligator clip adapter (for A01044)
A01036-1500	BNC-BNC cable (1.5 m)
A02263	Rack mount set (JIS 2U half)
A02264	Rack mount set (JIS 2U half twin)
A02463	Rack mount set (EIA 2U half)
A02464	Rack mount set (EIA 2U half twin)
A02039	Panel mount set (2U half)
A02040	Panel mount set (2U half twin)
1111	Terminal adapter

- Please read through the operation manual carefully before using the products.
- All specifications are subject to change without notice.



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